SHORE EROSION

OF

HOOVER RESERVOIR

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ABSTRACT

Reservoir planning and construction for the purpose of fresh water storage is a critical problem of many cities today. Several problems arise in the building of the dam and reservoirs due to the geology of the areas selected. In many instances the reservoir is ~~in~~ direly needed to alleviate a water shortage and the public pressures sometimes influence hasty but poor long range planning decisions. The results in a few years can be very expensive as is the case at hand for the City of Columbus.

Shore erosion of the soft Bedford shales and glacial tills along with siltation of the reservoir and increased hardness of the water have made the surface water storage and treatment process more costly than originally proposed. It is assumed that areas with similar problems might profit from this experience.

INTRODUCTION

The basic environmental problem of shore erosion is caused by a combination of factors. Primarily the soft bedrock, glacial tills and clay soils are subjected to the wave action brought about by the predominantly westerly winds and pleasure craft. In addition, other factors such as spring seepage, frost action along with ice-action damage, surface erosion, removal of vegetation and the rising and falling water level have been attributed to the cause. This in turn creates additional problems such as siltation or filling of the reservoir with the ensuing sediments thereby decreasing the impounding capacity of the reservoir. This condition also increases the turbidity or silt content of the water which increases the cost of filtration of the water.

The selection of this topic originated from the fact that many areas of the country today are faced with the same problems of increased demands for fresh water supply and dwindling fresh water resources along with the pressures brought about by growing municipalities. Many of these problems might be alleviated with more foresight and better planning, especially in acquiring sufficient land.

This study has been limited to verbal contact with the Division of Water, City of Columbus, some property owners of the area concerned, Soil and Water Conservation District, Franklin County and sight surveys.

Description of Area

Hoover Reservoir, a man-made impoundment was constructed by the City of Columbus, Ohio for the purpose of water supply and recreational use. Land acquisition began in 1953 with the completion of the earth dam and concrete spillway in 1956. The total cost of the project was $16,400.000 which includes:

land acquisition and legal fees	$4,540,000
dam and reservoir construction	7,896,000
roadway, bridge, cemetery and utility relocations	4,063,000

The present level of the reservoir (890' above sea level) has 45 miles of shoreline, covers 3300 surface acres, a watershed area of 190 square miles which is mainly farmland and holds nearly 20 billion gallons of water with a safe yield of 50 million gallons daily. With the 8-foot sluice or crest gates added and put into operation this past year the capacity was increased to 27 billion gallons of water with a safe yield of 60 MGD. This added capacity has increased the problems of shore erosion and private property destruction of the area.

Geology of the Area

The bedrock exposed in the area of Hoover Reservoir is of the Upper Devonian age and the Lower Mississippian system which dates back more than 300 million years ago. The two main formations that will be considered part of this project include, the Ohio shale and the Bedford shale although other more recent formations may enter or have some effect on the area. The boundary between these two formations is unusually well-marked by Big Walnut Creek, on which Hoover Reservoir is located. Figure 1 shows the section of the area involved. The east bank of the creek in many areas consists of exposures of the Bedford shale, while the west bank is predominately Ohio shale. The eastern side is usually considerably higher than the west and the western bank is commonly covered with a thick layer of glacial till. The creek seems to have shifted eastward to flow along the wall of a buried preglacial valley.

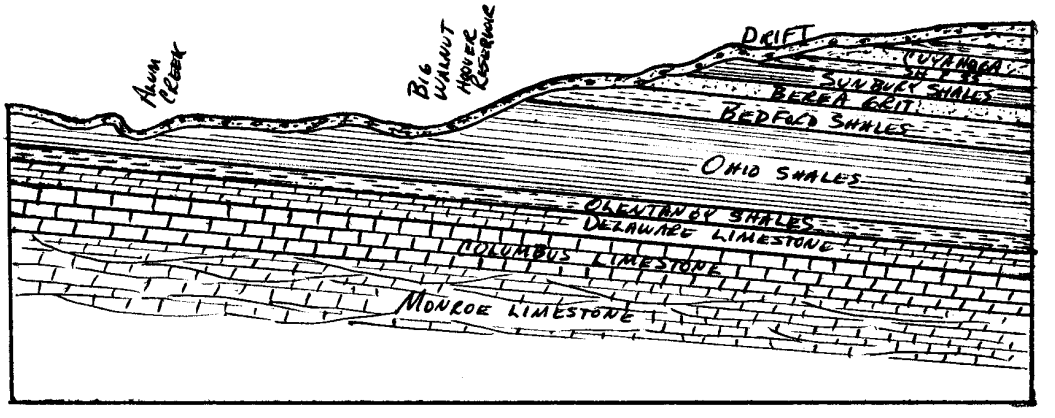


Figure 1. West to east horizontal bedrock section of Hoover Reservoir area.
(Geol. Survey Bulletin 14,1911 P. 36)

The Ohio shale which forms the channel of Big Walnut Creek which outcrops at the lower level of the east bank. "It is a brownish or bluish black shale in fresh exposures, but weathered surfaces have a distinctly blue color."[1] This shale is quite firm and somewhat massive when first exposed but breaks up into small fragments and into a stiff clay over a long period of weathering. The upper part of the formation contains numerous small flat concretions of iron pyrites which is quite obvious in the vicinity of Central College and just above the spillway. (See figure 2)

Figure 2. Iron pyrite concretions of Ohio shale

[1] Orton, Edward, Geol. Surv. Ohio, Vol 3, 1878, p.634

The Bedford shale formation forms most of the east shore of the present level of Hoover Reservoir. This is a very soft, easily eroded formation, full of hematite which gives it the characteristically red color especially when weathered. The hills east of the location of Central College were once well-known for their exposures of this red shale which gave its nickname locally "Red Hills."[2] Because of striking likeness of the topography of this area to the "Bad Lands"[2] of the West it has also assumed that name. (See figure 3 & 4)

Figure 3. "Bad Lands and Red Hills" Bedford shale of Central College

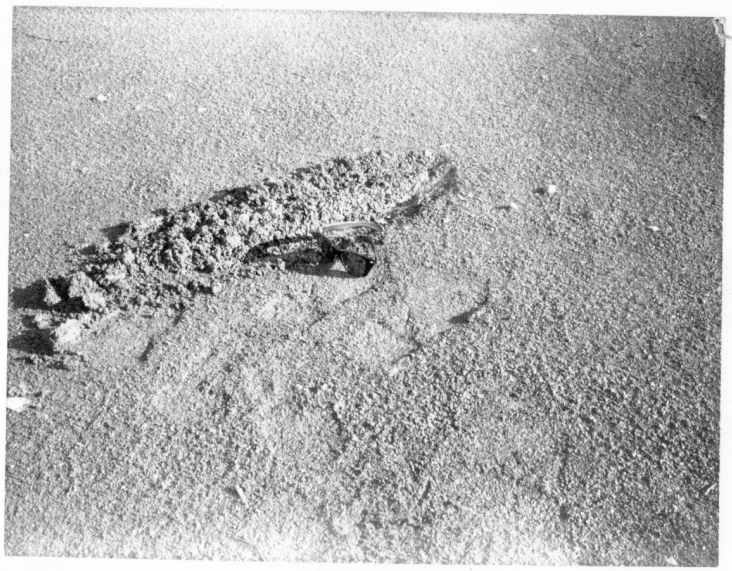


Figure 4. Close up of Bedford shale

[2] Bulletin 14, Geol. of Cols. Quad, 1911, p. 28

Soils of the Area

Hoover Reservoir, in addition to being located on the border of two rock formations, is on the border between two soil regions. These soils are mostly the Alexandria-Cardington[3] group for the greater part of the shore line. The soils on the east are less productive, more acidic, and more eroded than those on the west. As a result there is less plant cover supported by the soils and increased clay content with depth. This in turn restricts the growth of roots and movement of water through the soils which causes increased runoff and therefore more erosion.

Additional Problems

The other reasons for the shore erosion mentioned earlier which causes considerable damage is the change in the level of water. This of course causes extensive cutting at many levels. At the present time the level is 16 feet below the spillway level and many terraced erosional levels can be readily observed. (See figure 5 & 6) No plant cover can be established and therefore all the mechanical and chemical agents continue to destroy the shore. This practice leads to the increased siltation of the reservoir which is already at a peak because of the watershed being one of high erosion rate.

Because of increased turbity, silt content and some current action, the dissolving of many otherwise settled or absent mud,clay and silt particles takes place. This increases the hardness of the stored water which adds to the expense of softening chemicals in the treatment process.

3 Soil Survey Delaware County, Ohio, SCS, p. 38 p. 44

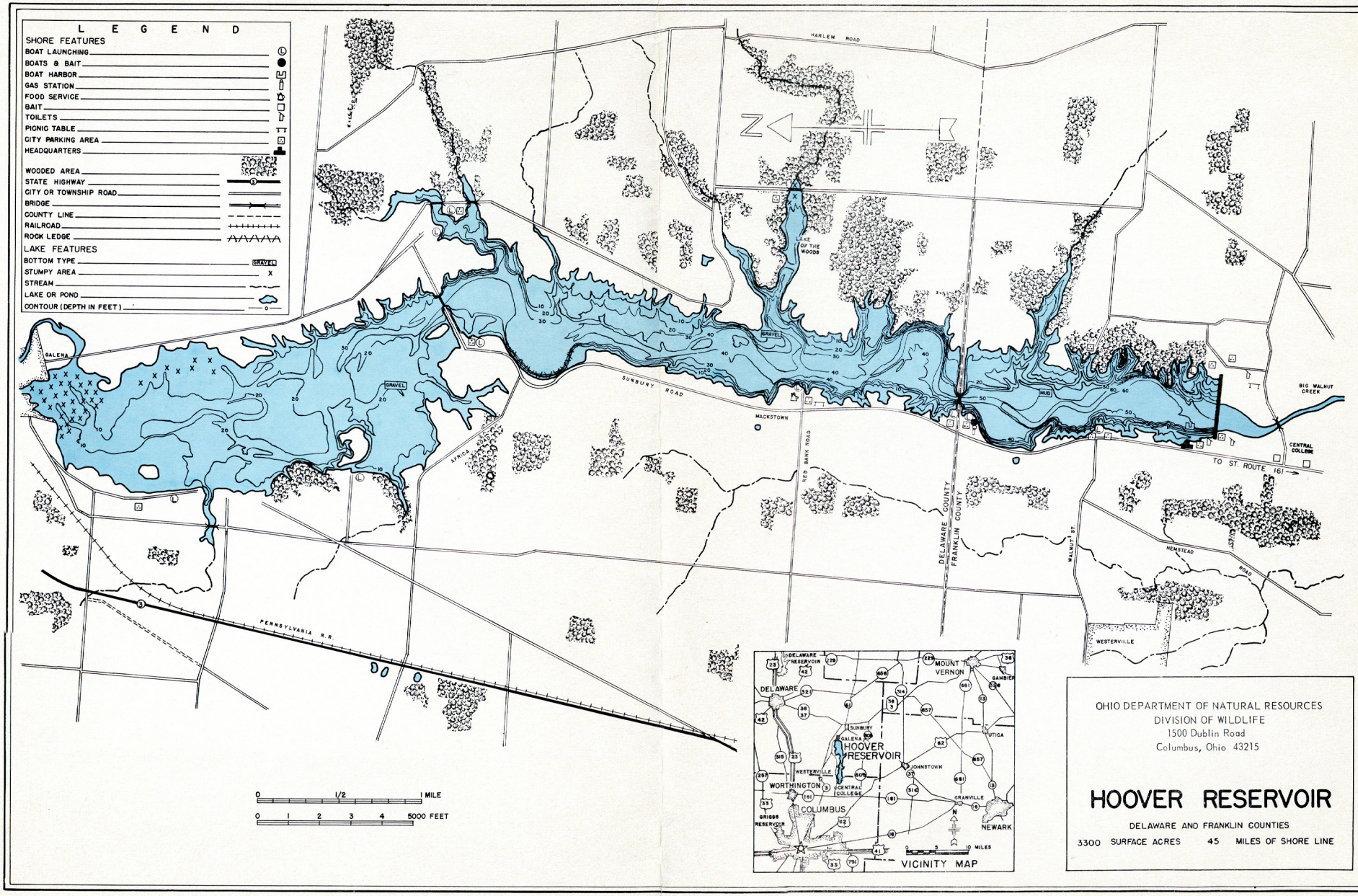
Alternative Solutions

A number of possible solutions have been proposed by as many different sources. A study has been made by Burgess and Niple Consulting engineers of the projected 50-year erosion rate. Many areas of the shore will erode up to 140 feet or more. The projected erosion rate was based on soil test boring, angle of repose and other studies. This would naturally result in the loss of valuable property and cut down considerably the capacity of the reservoir by siltation. Also it would bring about many lawsuits from private citizens. The city of Columbus is presently in the process of acquiring additional land for easements and erosion control. Total estimated cost of this plan will be about two and one half million dollars.

The most desirable method of control would be to "rip rap" the entire shore line. (See figure 7) However, this would cost upwards to $30 million, twice the cost of the original dam and reservoir. The second alternative and the one which the city seems to be taking is to purchase the additional 284 acres needed for right away and let it erode and "rip-rap" the most critical areas at a cost of $100 to $125 per lineal foot. Other less evident but never the less important processes can help reduce the problem and should be put into practice at once. This includes reforestation of the east slopes, controlling the level of the reservoir with less variations in exposures especially in the winter and more long range planning in the initial stages of building and land acquisition for a reservoir. Another alternative, dredging, would not be economically feasible at this time since a new reservoir could be built at less cost. Many similar situations could be avoided in the new Alum Creek Reservoir to the northwest of the location, and preserve what land might otherwise be lost in the future.

Figure 5 & 6. Terraced erosion east shore Hoover Reservoir

Figure 7. "Rip-Rap" at spillway
Hoover Reservoir



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HOOVER RESERVOIR

DELAWARE AND FRANKLIN COUNTIES

3300 SURFACE ACRES 45 MILES OF SHORE LINE